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Inhibitory efficiency of cumin powder in cryopreservation of beef burgers

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ABSTRACT

In the current study, the qualitative and sensory characteristics of cold-stored beef burger tablets were evaluated using cumin powder, as 0, 0.5 and 1% added to ground beef that was made into tablets, then the product was stored for 1, 5 and 10 days in refrigeration 4 °C. Some chemical and physical tests, oxidation indicators and sensory characteristics were conducted for this product. The results showed that the protein percentage in the samples to which cumin powder was added slightly increased insignificantly by the elevated concentrations of the added powder, as well as an upraise in the fat and ash rates (%) throughout the storage period, offset by an insignificant decrease in the percentage of moisture compared to the control. The highest values of water-carrying capacity of beef were recorded for cold-stored beef burgers, which elevated by the increased concentrations of cumin powder. The pH values increased slightly and insignificantly, while the loss during cooking recorded a slight and insignificant drop by the upraised concentration of cumin powder throughout the storage period. In addition, there was a decrease in the number of PV peroxide, thiobarbituric acid (TBA), the percentage of free fatty acids FFA and the percentage of TVN compared to the control. It was also noted that the treatments to which cumin powder was added had an effect in reducing the total number of bacteria, cold-loving bacteria and coliform bacteria in beef during cold storage. Compared to the control group, adding cumin powder led to an elevation in the values of flavor, juiciness, and freshness and general acceptance. In conclusion, it is possible to use cumin powder at a rate of 0.5 and 1% in beef tablets, which improved the studied chemical, qualitative and sensory characteristics, decreased oxidation indicators of beef, and the upraised storage life of the product throughout the period of cold storage for 10 days without any alteration in the quality and sensory qualities of the product.

Keywords: Beef burger, Cumin, Antioxidants.
Article type: Research Article.

INTRODUCTION

Meat is the main source of human nutrition, since it is a nutritional source of high nutritional value. It contains proteins that provide the body with essential amino acids necessary for growth. It also contains vitamins, and some mineral elements, especially iron. At low temperatures, it does a great job in preserving it for longer periods until it is consumed, which can be obtained at all times without reaching the stage of damage (Moawad *et al.* 2015). Meat and its products are exposed to damage when stored due to its chemical nature and the nutritional components it contains. The damage is chemical or microbial, which are the two factors affecting the quality of meat. Meat is also exposed to fat oxidation during manufacturing and storage processes due to the wide surface area (Sharma *et al.* 2016). Therefore, the researchers were interested in using antioxidants to maintain the quality of meat by inhibiting self-oxidation in meat and meat products (Srinivasan 2018). The plant extracts are substances that contain several groups of compounds such as phenols, flavonoids and sulfhydryl compounds that contribute to the antioxidant activity. Therefore, it was directed towards the use of antioxidants from natural sources to prevent food spoilage (Dubey *et al.* 2017; Kadhim & Younis 2023; Salim 2023; Ahmed *et al.* 2023). The cumin

plant, *Cuminum cyminuml*, is a winter annual herbaceous plant belonging to the *Apiaceae* family. It is one of the most widely consumed spice plants in the world. It is native to Egypt, Iran, and Mediterranean (Al- Anbari *et al.* 2013). Cumin has been known since ancient times for its uses in the food industry, especially meat and fish, as it imparts flavour and taste, and in the manufacture of bread and pastries. The Babylonians and ancient Egyptians used it as a spice and medicine, and the Pharaohs used it to embalm their dead (Cushnie *et al.* 2014). It is used in the pharmaceutical industry to treat diarrhoea, toothache, intestinal disorders, and anti-inflammatory (Gualano *et al.* 2015). A number of studies have been very interested in obtaining natural antioxidants instead of industrial antioxidants because of the problems they cause that affect the health of the consumer. Natural plants as a natural source of safety due to their low side effects and the possibility of obtaining them from cheap and available sources in the local markets, are considered as one of the favourite spices in preparing meals (Sandeep *et al.* 2016). Cumin contains effective compounds such as sterols, theanines, flavonoids, amino acids and glycosides. It also contains effective chemical compounds towards microorganisms (bacteria and fungi), especially phenolic compounds, aldehydes, ketones and alcohols such as Linalool, Terpinene, Eugenol (Patil *et al*. 2016; Dubey *et al*. 2017). The present study aimed to evaluate the effectiveness of cumin powder in preserving bovine Bircher tablets as antioxidants and antimicrobials during cold storage, in addition to evaluation of the its effectiveness on some physical and sensory characteristics of bovine peregrine stored for a period of 1, 5 and 10 days at a temperature of 4 °C.

MATERIALS AND METHODS

The study was conducted in the laboratories of the Market Research and Consumer Protection Center, University of Baghdad, Iraq. Beef (thigh area) was purchased from Al- Karkh shops in Baghdad. Cumin powder was prepared and finely ground using a laboratory grinder and added directly to the meat at proportions of 0, 0.5, 1% of the of the meat weight, which was 2 kg for each sample. In addition, 5% filler (crushed crumbs), pure table salt at a rate of 0.6%, black pepper at a rate of 0.4%, and crushed garlic at a rate of 0.3% were added and then mixed manually after chopping the meat using a meat grinder with a diameter of 8 mm. Afterward, we prepared homemade mold discs and then kept in polyethylene bags inside the refrigerator at a temperature of 4 °C, to conduct chemical, physical, microbial and sensory examinations for a period of 1, 5 and 10 days.

Chemical analysis of meat

Estimation of the chemical composition of meat

The chemical composition of beef (Burger) was estimated according to the methods mentioned in AOAC (2010). The moisture was estimated by drying 2 g Burger at 105 °C until the weight was constant. The Microkjeldahl method was used to estimate the nitrogen content, which was multiplied by a conversion factor of 6.25 to obtain the protein content. The fat content was determined in the soxhlet extraction unit using petroleum ether for a period of hours. Ash content was estimated in the incinerator at a temperature of 525°C for 16 h.

Chemical details

Peroxide value (POV)

The method (AOAC 2010) was used by mixing 5 g of the sample and mixing 15 mL distilled water followed by mixing for one minute, adding 20 mL sodium dodecyl sulphate (SDS) and shaking the solution for two min, adding 40 mL ethanol, shaking the solution for two minutes, then adding 20 mL Hexane. The solution was shaken for 1 min and a half, then the clear solution was separated by centrifugation for 20 min. Afterward, the oil layer formed on the surface of the liquid was separated and pulverized with 0.01% potassium hydroxide molarity. The values were calculated in meq/kg fat by using the following equation:

$$\textbf{Peroxide value mEq/kg lipid} = \frac{\textbf{The number of milliliters of potassium hydroxide} \times \textbf{N}}{\textbf{weight of Model}} \times \textbf{1000}$$

Estimation of the thiobarbituric acid (TBA) value

It was estimated according to the method described by Witte *et al.* (1989). An amount of 1 g Barker sample was mixed with 25 mL of a cold solution containing 20% trichloroacetic acid (TCA) dissolved in 2 mole of phosphoric acid and placed in the homogenizer and for 2 minutes. Then we transferred the mixture to a volumetric flask with a capacity of 50 mL, completed the volume to the mark with distilled water, vortexed the mixture. Afterward, we

took 25 mL, and centrifuged it at a speed of 3000 rpm for 30 min, followed by filtering the mixture with filter paper, and then transferring 5 mL from the filtrate to test tube and adding 5 mL of a thiobarbituric reagent solution with a concentration of 0.005 mole. Planck's solution was prepared by mixing 5 mL distilled water with 5 mL reagent solution. The contents of the test tubes were mixed well, closed tightly, and kept in a sterile place for 16 hours at room temperature. The contents were heated in a water bath for 35 min. Thereafter, the absorbance (A) of the resulting colour was measured at a wavelength of 530 nm using a spectrophotometer. The value of thiobarbituric acid was calculated by multiplying the absorbance value by a coefficient of 5.2. The value was expressed on the basis of mg malondehyde / kg meat and according to the following equation:

$$\text{Thiobarbituric acid value (mg malondialdehyde/kg meat)} = A \times 5.2$$

Determination of total volatile nitrogen (TVN)

The total volatile nitrogen in samples of bovine Berger was estimated according to the method mentioned by Al-Taie & Al-Moussawi (1992). It was performed by mixing 100 g of the sample with 300 mL of a 5% trichloroacetic acid solution, then filtering the mixture to obtain a clear extract, followed by transferring 5 mL of the clear extract to a distillation flask (Kjeldahl) and adding 5 mL sodium hydroxide solution (2M). Afterward, the Kjeldahl apparatus was connected and the mixture was heated. The dripping liquid was received in the receiving flask, as it contained 15 mL boric acid. Its concentration was 4%, with drops of methyl red, bromine, and green chloride adding to it. Thereafter, the mixture was purified using sulfuric acid with a concentration of 0.01 M. The amount of total volatile nitrogen was calculated according to the following equation:

$$\text{TVN (mg N / 100 g)} = \text{Titration } [H_2So_4\ 0.1\ \text{N (mL)}] \times 14$$

Determination of Free Fatty Acids (FFA)

It was estimated according to the method of Al-Taie *et al.* (1992), when 25 mL ethyl ether was mixed with 25 mL ethyl alcohol 98% and 1 mL 1% phenolphthalein solution. Afterward, it was accurately neutralized by a basic (0.1 M) standard solution. An amount of 10 g of the sample was placed in the prepared solution and filtered, then the filtrate was dissolved with sodium hydroxide (0.1 M) followed by titration until the appearance of a pink colour, which remains constant for 15 seconds. Then the pH number is calculated according to the equation:

$$\text{Number of acid} = \frac{\text{The number of milliliters of sodium hydroxide x } 5.61}{\text{sample weight (g)}}$$

$$\text{Free fatty acids (\%)} = \frac{\text{acid number}}{2}$$

Physical properties

The hydrogen number was estimated according to the method of Capita *et al.* (2006) by weighing 5 g of the sample and adding 20 mL distilled water to it, then shaking and mixing with an electric mixer for 5 min. The sample was filtered with filter paper, and the filtrate was taken. The pH was measured directly using the pH meter. The ability of the meat to hold water (WHC) was estimated according to the method of Dolatowski & Stasiak (1998) by taking 50 g of the sample and homogenizing it with 50 mL distilled water for one minute, using the TAFESA to be naturalized and centrifuging to homogenize mixture at a temperature of 4 °C at a speed of 5000 rpm for a period of time, i.e., ten minutes and according to the percentage as follows:

$$\text{Water holding capacity (\%)} = \frac{\text{Weight of water added to meat} - \text{weight of water after centrifugation}}{\text{weight of sample (g)}} \times 100$$

The loss in weight during cooking was estimated according to the method mentioned by Dolatowsk & Stasiak (1998) by heating the burger patties on a hot plate for 10 min, with stirring until heating was completed (by applying two drops of oil). The percentage of loss was calculated as follows:

$$\text{Weight loss during cooking \%} = \frac{\text{Weight of the sample before cooking} - \text{Weight of the sample after cooking}}{\text{Weigh of sample before cooking}} \times 100$$

Microbial examinations

The presented method was followed by Kassem *et al.* (2011) in estimating the total number of bacteria by using the pour plate method, as the nutrient agar medium was used and the dishes were incubated at 37 °C for 24 h. The numbers of coliform bacteria were estimated using MacConkey Agar medium and incubation at 37°C for 24 h. In the case of the psychrophilic bacteria, their numbers were estimated using Nutrient Agar medium and incubated at a temperature of 4°C in the refrigerator for 5-7 days.

Sensory evaluation of bovine burger

The sensory evaluation of the refrigerated stored beef burger was conducted after each storage period (1, 5 and 10 days). The method mentioned by Tahir (1979) was adopted: The beef burger was fried using a hot plate, and evaluated by specialists in food sciences in the Centre for Market Research and Consumer Protection centre, University of Baghdad who have experienced in the field of sensory evaluation, including each of the flavour, juiciness, freshness and general acceptance.

Statistical analysis

The statistical program (SAS-Statistical Analyses system 2018) was used in data analysis to study the effect of different coefficients on the studied traits according to a complete random design (CRD) and two-way coefficients and durations, The significant differences between the averages were compared with the Least Significant Difference-LSD test ($p < 0.05$).

RESULTS AND DISCUSSION

Chemical examination

Table 1 depicts the effect of adding cumin powder on the chemical composition of the chilled bovine burger tablets. A slight and non-significant increase in the moisture content was observed by adding 0, 0.5 and 1% for all storage periods at 1, 5 and 10 days compared to the control. The moisture amounted to 59.72, 59.70, 59.24% for the first treatment, 60.12, 60.00, 59.43% for the second treatment, and 60.22, 60.11, 59.22% for the third treatment, in accordance with Ibtisam & Adil (2016). Notably, there was a drop in the humidity percentage by the increased storage periods, leading to an elevation in the percentage of protein, fat and ash, which was due to the evaporation of moisture from the surface of the cold-stored meat discs. During the storage periods, the protein rate (%) in the first treatment reached 16.04, 16.33, 16.58%, the second treatment 16.42, 16.73, 16.81%, and the third treatment reached 16.80, 17.03, 18.11%, however, this increase was not significant. In the case of fat, we observed a drop. By a rise in the storage period, a significant elevation in the dry matter including protein, fat and ash was observed which was due to the loss of moisture, consistent with the results obtained by Al-Alwani (2017). In the present study, we observed an elevation in the ash rate (%) with an upraise in the addition rates and storage periods. By the progression of the storage period, the moisture decreased, while the dry matter (including protein, fat and ash) upraised, in agreement with Muhammad (2018). Table 2 shows the effect of adding cumin powder on the values of the PV peroxide by beef stored in refrigeration for different periods, as it was noted that a significant decrease occurred in its value by elevating the amount of cumin compared to the control. This decrease may be due to the fact that cumin powder contains phenolic compounds comprising hydroxyl groups, which work to slow down fat oxidation by inhibiting and curbing free radicals, thus delaying the formation of peroxides and hydroperoxides. Adding these substances works to prevent rancidity compounds from developing, such as ketones and aldehydes, as they are indicators of food oxidation from the chemical indicators of the quality and quality of meat. The growing interest in natural antioxidants is observed due to their high and strong effectiveness in improving the stability of fats and its low toxicity compared to industrial antioxidants such as BHA and BHT, in agreement with Mccarthy *et al.* (2001).

Table 1. Effects of adding cumin powder on the chemical composition of beef brisket patties, stored at 4 °C.

Chemical content	Transactions	Storage period			LSD value
		1	5	10	
Humidity %	T_1	59.72 ± 2.78 a A	59.70 ± 1.67 a B	59.24 ± 2.37 Ba A	3.39*
	T_2	60.12 ± 2.94 a A	60.00 ±3.08 a AB	59.43 ± 2.35 a AB	3.57*
	T_3	60.22 ± 2.73 a A	60.11 ± 2.28 a A	59.22 ± 1.94 a A	NS3.07
LSD value	...	NS 3.93	NS 3.72	NS 3.68	...
Protein (%)	T_1	16.4 ± 0.93	16.33 ± 0.66	16.58 ± 0.71	NS 1.55
	T_2	16.42 ± 0.74	16.73 ± 0.92	16.81 ± 0.69	NS 1.49
	T_3	16.80 ± 0.69	17.03 ± 0.75	18.11 ± 1.92	2.94
LSD value	...	NS 1.46	NS 1.27	NS 1.52	...
Fat (%)	T_1	14.55 ± 0.51 a B	14.91 ± 0.62 b AB	15.33 ± 0.59 ab AB	1.19 *
	T^2	13.94 ± 0.38 b Ba	14.43 ±58.1 ab AB	14.92 ± 0.68 ab AB	1.07
	T_3	13.28 ± 0.54 b B	13.86 ± 0.48 b B	14.34 ± 0.51 b AB	1.18
LSD value	...	NS 1.26	NS 1.18	NS 1.16	...
Ash (%)	T_1	1.52 ± 0.08 b B	1.78 ± 0.10 b AB	1.92 ± 0.11 A b	0.328*
	T_2	1.62 ± 0.09 b Ba	1.82 ± 0.08 ab AB	1.96 ±0.09 ab AB	0.371*
	T_3	1.72 ± 0.08 b Ba	1.85 ± 0.08 ab AB	1.99 ± 0.12 ab AB	0.288*
LSD value	...	NS 0.419*	NS 0.361*	NS 0.383*	...

Note: Averages with lowercase letters within one column (coefficients) and uppercase letters within one row between periods are significantly different among them * (P≤0.05). (P≤0.05), NS is not significant, the values in the table are averages of two replicate treatments **T_1**: without addition, **T_2**: 0.5% of cumin powder, **T_3**: 1% of cumin powder.

In the case of the effect of cold storage periods (1, 5 and 10 days) on increasing the PV values, this is a natural reflection of the occurrence of the oxidation process of the fat during the storage period by the action of lipolytic enzymes (Raj & Dwivedi 2011). The effect of adding cumin powder is observed in the values of thiobarbituric acid (TBA) of beef stored in refrigeration for different periods, since the TBA values decreased by elevating the amount of cumin and for all storage periods (1, 5 and 10 days) compared to the control, which exhibited elevation by the storage periods The reason for the decrease may be due to its compounds. The phenolic compounds contained in cumin powder, works to suppress the free radicals of fats and prevent the decomposition of hydroperoxides into free radicals. These compounds exhibit the ability to donate a hydrogen atom to the free radical of the unsaturated fatty acid formed during the process of fat oxidation. The results of these oxidation indicators are in agreement with the Iraqi standard specification issued by the Central Organization for Standardization 2688 of 1987 for red meat and poultry products, chilled and frozen. It stipulates that the TBA value should not exceed 2.0 mg of malonaldehyde / kg of meat and PV of more than 10 meq/ kg of fat, since it is considered as unacceptable. We noticed that the percentages of free fatty acids (FFA) decreased significantly by an elevation in the amount of powder added and for all storage periods (1, 5 and 10 days) compared to the control. The reaction is carried out by donating a hydrogen atom to the fatty acid and free radicals (Jordan *et al.* 2014). In the case of TVN values, they decreased throughout the storage periods compared to the control, since cumin powder contains effective compounds that have a natural antioxidant effect on cold-stored beef. It was in agreement with Andres *et al.* (2014), and also in agreement with the standard specification the number 2688 in 1987, which stipulates that TVN values should not exceed 14 mg / 100 g of meat.

Table 2. Effect of adding cumin powder on the values of (PV, TBA, FFA%, TVN) for stored beef by cooling.

Description	Transactions	Storage period			LSD value
		1	5	10	
PV	T1	1.15 ± 0.06 a B	2.89 ± 0.11 a A	3.33 ± 0.15 a A	1.06*
	T2	1.11 ± 0.08 a B	1.79 ± 0.09 a AB	2.19 ±0.10 ab AB	1.18*
	T3	1.09 ± 0.09 a A	1.18 ±0.09 a A	1.58 ± 0.08 b A	0.866 NS
LSD value	...	0.428 NS	0.398 NS	1.019*	...
TBA	T1	1.15 ± 0.05 a C	1.17 ± 0.08 a C	1.47 ± 0.05 a B	0.286*
	T2	0.92 ± 0.03 ab B	1.12 ± 0.06 a AB	1.22 ± 0.03 ab A	0.271*
	T3	0.88 ±0.08 ab B	1.10 ± 0.06 a AB	1.16 ± 0.06 b AB	0.307*
LSD value	...	0.272 NS	0.293* NS	0.307 *	...
FFA (%)	T1	0.26 ± 0.02 a B	0.54 ± 0.06 a AB	0.66 ± 0.05 a A	0.291*
	T2	0.12± 0.02 a B	0.39±0.004 ab AB	0.57± 0.03 a A	0.315*
	T3	0.10±0.03 a B	0.12± 0.02 b B	0.26±0.03 ab AB	0.266*
LSD value	...	0.225 NS	0.288*	0.307 *	...
TVN (%)	T1	10.90 ± 0.56 a A	10.98 ± 0.47 a A	11.03 ± 0.75 a A	0.773 NS
	T2	8.32 ± 0.37 b A	8.43 ± 0.52 b A	8.49 ± 0.57 b A	0.604 NS
	T3	8.24 ± 0.53 B A	8.28 ± 0.66 B A	8.45 ±0.48 B A	0.637 NS
LSD value	...	1.274*	1.086*	1.237*	...

Note: Averages with lowercase letters within one column (of coefficients) and uppercase letters within one row between periods are significantly different among them * ($P \leq 0.05$); NS is not significant; values in the table are averages of two replicate treatments T_1: without addition; T_2: 0.5% of cumin powder; T_3: 1% of cumin powder.

Table 3 showed the effect of adding cumin powder on some physical properties of stored bovine burger tablets, as a rise in the pH value is noted by increasing the added amount of cumin powder and increasing the storage period compared to the control in which the pH value decreased by elevating the storage period. The reason for the elevation in the pH value is due to upraise in the protein content by increasing the amount of cumin powder added. It works by elevating the amount of water associated with it, hence raising the pH and moving away from the electro-neutral point and improving the solubility of proteins (Dubey *et al.* 2017). The decrease in the pH value of the control treatment is due to an elevation in the storage period because of the liberation of free fatty acids by the action of lipolytic enzymes such as the lipase enzyme, and by the action of fermentation that occurs to the rest of the glycogen stored in the muscles by the action of meat enzymes and the formation of lactic acid by the action of lactic acid bacteria (Auroba *et al.* 2010). In the case of the ability to retain water, it was noted that there is an increase in its value for T_3 and T_2 compared to the control treatment (T_1) and for all periods of cold storage (1, 5 and 10 days). The high water retention capacity may be due to an elevation in the pH and protein content in the meat of the addition treatments which increases the ability of the meat to hold water by a greater amount, which contributes to the high value of WHC. The upraise in the solubility of meat proteins works to increase the binding with water. Adding natural antioxidants to meat and its products preserves the water associated with meat proteins, leading to a high susceptibility of meat to carry water (Moawad *et al.* 2015). In the case of the loss during cooking, its value dropped by increasing the amount of cumin addition compared to the control coefficient T_1 and by elevating the storage periods (1, 5 and 10 days) or perhaps due to the interaction pattern of natural antioxidants in increasing the ability of meat tissues to retain water and reducing water loss during storage (Juarez *et al.* 2012). The high value of this characteristic was observed in the control treatment T_1

with an upraise in the storage period due to the low pH value that reduced the ability to retain and hold water (Raj & Dwivedi 2011).

Table 3. the effect of adding cumin powder on some physical properties of stored beef patties by cooling.

Description	Transactions	Storage period			LSD value
		1	5	10	
pH	T1	5.95 ± 0.07 a A	5.91 ± 0.25 A	5.84 ± 0.21 A	O.572 NS
	T2	5.98 ± 0.11 a A	6.30 ± 0.17 AB	6.44 ±0.24 AB	O.482 NS
	T3	6.10 ± 0.17 A	6.35 ±0.21 A	6.46 ± 0.21 A	* 0.669
LSD value	...	0.805*	0.473 NS	0.491* NS	...
WHC%	T1	30.29 ± 1.07 b A	40.37 ± 1.69 b A	42.89 ± 1.53 b A	5.28 NS
	T2	48.35 ± 1.35 a A	49.40 ± 1.83 a A	50.19 ± 1.79 a A	4.33 NS
	T3	53.59 ± 2.12 a A	54.20 ± 2.06 a A	56.40 ± 2.19 a A	4.16 NS
LSD value	...	6.89*	7.02*	0.307 *	...
Loss during cooking %	T1	30.56 ± 1.09 b A	32.48 ± 1.22 a A	36.09 ± 1.46 a A	*2.85
	T2	30.29 ± 1.26 a A	30.11±1.07 a A	28.86 ± 1.14 a A	*2.91
	T3	28.20 ±2.05 a A	24.26 ± 1.37 a A	20.40 ± 1.06 a A	*2.88
LSD value	...	1.96 NS	1.67 NS	1.33 NS	...

Averages with lowercase letters within one column (coefficients) and uppercase letters within one row between periods are significantly different among them * ($p \leq 0.05$); NS is not significant, the values in the table are averages of two replicate treatments T_1: without addition, T_2: 0.5% of cumin powder, T_3: 1% of cumin powder.

Table 4 shows the effect of adding cumin powder on the numbers of bacteria in the stored beef patties. It was noted that the numbers of total bacteria, coliform bacteria and psychrophilic bacteria decreased by the elevated amounts of cumin addition, while the growth rates increased slightly by an upraise in the storage period to 10 days compared to the control. This may be due to the fact that cumin powder contains effective compounds that cause changes in the cellular components of bacteria, such as the production of proteins and nucleic acid, as well as an increased sensitivity of the bacterial cell wall and a change in the permeability of the wall and the process of transfer of materials and electrons through it. It also inhibits the action of some important interactions that lead to bacterial inhibition and then death. These results are consistent with those found by Dubey *et al.* (2018). These results was agreement with Sharma *et al.* (2016) and also with the Iraqi standard specification for the Central Agency for Standardization and Quality Control (2600) regarding the acceptable quality of meat and its products, which states that the total number of bacteria should be within 1×10^6 CFU /g of meat, as the estimation of the total bacterial number of meat and meat products is an appropriate indicator for judging the quality of the raw material and the way it is handled and stored. Table 5 presents the sensory evaluation of the product of beef patties manufactured by adding different concentrations of cumin powder. It was noted from the table that the flavour was distinguished in treatment T_3 and T_2 by slight significant differences from its value in treatment T_1 in the storage periods (1, 5 and 10 days). It may be due to fact that adding cumin powder exhibits an inhibitory effect on oxidation by reducing the values of oxidation indicators, and it plays a role in inhibiting the rancid flavour compounds apparent in meat and meat products (Kim & Chin 2015).

Table 4. Effect of adding cumin powder on the microorganisms of stored in bovine meat in refrigerator.

Microbial examination	Pure meat without addition	Transactions	Storage period			LSD value
			1	5	10	
Total of bacteria account	20×10^5	T_1	6×10^5	18×10^5	30×10^5	23.68 *
		T_2	6×10^4	13×10^4	26×10^4	18.55 *
		T_3	3×10^4	9×10^4	13×10^4	15.29 *
		LSD value	73.29 *	61.02 *	55.46 *	----
Psychrophilic bacteria	5×10^5	T_1	3×10^5	10×10^5	18×10^5	22.45 *
		T_2	6×10^4	7×10^4	9×10^4	12.07 NS
		T_3	4×10^4	6×10^4	12×10^4	15.22 NS
		LSD value	56.03 *	41.92 *	47.24 *	----
Total of coliform bacteria	3×10^2	T_1	1×10^2	3×10^2	6×10^2	8.63 NS
		T_2	zero	zero	zero	NS
		T_3	zero	zero	zero	NS
		LSD value	14.38 *	17.52 *	17.97 *	----

Note: $P \leq 0.05$. NS is not significant. The values in the table are averages of two replicates. T_1: without addition, T_2: 0.5% cumin powder, T_3: 1% cumin powder.

The sensory evaluation scores reached 5.31, 5.76, 5.91 for the first treatment, 6.30, 6.51, 6.66 for the second treatment, and 6.62, 6.65, 6.70 for the third treatment during the mentioned storage periods, respectively. This is due to the meat high ability to hold water due to the addition of cumin powder. A decrease in the values of juiciness is noted by an elevation in the storage period. It also may be due to the high loss during cooking, which affects the juiciness. The improvement in the general acceptance is due to the increase in flavour, juiciness and freshness, which was reflected in the degree of general acceptance and improving its degrees. These results were consistent with Chaudhary *et al.* (2014).

Table 5. Sensory evaluation of beef patties product (Al-Burker) stored refrigerated at 4 °C.

Storage period	Transactions	Sensory qualities			
		Flavor	Juiciness	The freshness	General admission
1	T_1	5.65	5.91	5.82	5.82
	T_2	6.31	6.66	6.51	6.22
	T_3	6.86	6.70	6.53	6.65
5	T_1	5.56	5.76	5.67	5.65
	T_2	6.15	6.51	6.33	6.06
	T_3	6.82	6.65	6.49	6.48
10	T_1	5.46	5.31	5.48	5.42
	T_2	6.00	6.30	6.21	6.00
	T_3	6.67	6.62	6.33	6.31
		1.169*	0.944*	0.781 NS	0.873*

Note: $p \leq 0.05$; NS: not significant. The values in the table are averages of two replicates of the treatments. T_1: without addition, T_2: 0.5% cumin powder, T_3: 1% cumin powder.

It is concluded from the results of this study that cumin powder can be used to extend the preservation period of beef in refrigeration while improving its chemical, qualitative and sensory characteristics without appreciable changes in the general characteristics of the product, as well as its use as a natural preservative instead of the industrial preservatives used in meat preservation.

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